

1 In the claims:

2 1. A memory device capable of calibration, comprising:

3 a substrate;

4 an array of memory cells disposed over the substrate;

5 a plurality of first conductors;

6 a plurality of second conductors, wherein the first conductors cross the second

7 conductors at the memory cells;

8 a first current source selectively coupled to the first conductors and capable of

9 providing a first write current to selected first conductors;

10 a second current source selectively coupled to the second conductors and capable

11 of providing a second write current to selected second conductors;

12 a controller, wherein the controller controls the application of the first and second

13 write currents to the array of memory cells; and

14 a temperature sensor disposed in the memory device to sense a temperature of the

15 memory device, wherein data from the temperature sensor are used to update the first and

16 second write currents.

17 2. The memory device of claim 1, comprising:

18 a third current source selectively coupled to the second conductors and capable of

19 providing a third write current to selected second conductors.

20 3. The memory device of claim 1, comprising:

21 a reference memory cell, wherein data from the reference memory cell are used to

22 update the first and second write currents.

23 4. The memory device of claim 3, wherein the controller applies write currents to

24 the reference memory cell to determine write current values that cause the reference

25 memory cell to change state.

26 5. The memory device of claim 1, wherein the controller accesses stored write

27 current values to update the first and second write currents.

28 6. The memory device of claim 1, wherein the memory cells are magnetic

29 random access memory (MRAM) cells.

30 7. A method of calibrating a memory device, the memory device comprising an

31 array of memory cells, a plurality of first conductors and a plurality of second conductors,

32 the method comprising:

33 detecting a temperature of the memory device;

1           determining whether the temperature of the memory device has changed by at  
2   least a threshold value; and  
3           updating at least one write current value if the temperature of the memory device  
4   changed by at least the threshold value.  
5           8. The method of claim 7, wherein the step of detecting a temperature of the  
6   memory device comprises:  
7           periodically detecting a temperature of the memory device during operation of the  
8   memory device.  
9           9. The method of claim 7, comprising:  
10          updating a calibration temperature by assigning the calibration temperature a  
11   value at least substantially equal to the detected temperature if the temperature of the  
12   memory device changes by at least the threshold value.  
13          10. The method of claim 7, wherein the step of updating at least one write current  
14   value comprises:  
15          applying a first write current and a second write current to conductors crossing at  
16   a reference memory cell.  
17          11. The method of claim 10, wherein the step of updating at least one write  
18   current value comprises:  
19          detecting whether a state of the reference memory cell changes.  
20          12. The method of claim 11, wherein the step of updating at least one write  
21   current value comprises:  
22          updating the at least one write current value according to the first write current  
23   and the second write current if the state of the reference memory cell changes.  
24          13. The method of claim 11, wherein the step of updating at least one write  
25   current value comprises:  
26          increasing the first write current and the second write current if the state of the  
27   reference memory cell does not change.  
28          14. The method of claim 7, wherein the step of updating at least one write current  
29   value comprises:  
30          a.       applying a first write current and a second write current to conductors  
31                  crossing at a reference memory cell;  
32          b.       detecting a state of the reference memory cell;  
33          c.       increasing the first write current and the second write current if the state of  
34                  the reference memory cell does not change;

1           d.       repeating steps a-c until the state of the reference memory cell changes  
2           from a first state to a second state; and  
3           e.       updating the at least one write current value according to the first write  
4           current and the second write current when the state of the reference memory cell  
5           changes.  
6           15. The method of claim 14, wherein the step of updating at least one write  
7           current value comprises:  
8           f.       applying a third write current and a fourth write current to the conductors  
9           crossing at the reference memory cell;  
10          g.       detecting a state of the reference memory cell;  
11          h.       increasing the third write current and the fourth write current if the state of  
12          the reference memory cell does not change;  
13          d.       repeating steps f-h until the state of the reference memory cell changes  
14          from the second state to the first state; and  
15          e.       updating the at least one write current value according to the third write  
16          current and the fourth write current when the state of the reference memory cell  
17          changes.  
18          16. The method of claim 7, wherein the step of detecting a temperature of the  
19          memory device comprises:  
20          detecting a temperature of the array of memory cells.  
21          17. The method of claim 7, wherein the wherein the step of updating at least one  
22          write current value comprises:  
23          accessing at least one stored write current value associated with the detected  
24          temperature.  
25          18. A method of filling a table with write current values for use in calibrating a  
26          memory device, wherein the write current values are associated with temperature values,  
27          the memory device comprising an array of memory cells, a plurality of first conductors  
28          and a plurality of second conductors, the method comprising:  
29          a.       applying a first write current and a second write current to conductors  
30          crossing at a reference memory cell when the memory array is at a temperature;  
31          b.       detecting a state of the reference memory cell;  
32          c.       increasing the first write current and the second write current if the state of  
33          the reference memory cell does not change;

- 1 d. repeating steps a-c until the state of the reference memory cell changes  
2 from a first state to a second state; and
- 3 e. storing the first write current value and the second write current value that  
4 cause the state of the reference memory cell to change, wherein the first and  
5 second write current values are associated with the temperature.
- 6 19. The method of claim 18, comprising:
- 7 f. changing the temperature of the array;
- 8 g. repeating steps a-c until the state of the reference memory cell changes  
9 from a first state to a second state; and
- 10 h. storing the first write current value and the second write current value that  
11 cause the state of the reference memory cell to change, wherein the first and  
12 second write current values are associated with the temperature.
- 13 20. The method of claim 18, comprising:
- 14 i. applying a third write current and a fourth write current to conductors  
15 crossing at the reference memory cell when the memory array is at a temperature;
- 16 j. detecting a state of the reference memory cell;
- 17 k. increasing the third write current and the fourth write current if the state of  
18 the reference memory cell does not change;
- 19 l. repeating steps i-k until the state of the reference memory cell changes  
20 from the second state to the first state; and
- 21 m. storing the third write current value and the fourth write current value that  
22 cause the state of the reference memory cell to change, wherein the third and  
23 fourth current values are associated with the temperature.